DOCUMENT RESUME

ED 174 067 HE 011 404

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TITLE An Empirical Model for the Use of Biglan's Disciplinary Categories. AIR Forum 1979 Paper.
PUB DATE May 79
NOTE 36p.; Paper presented at the Annual Forum of the Association for Institutional Research (19th, San Diego, California, May 13-17, 1979)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Classification; Cluster Grouping; Comparative Analysis; Correlation; *Departments; *Faculty Workload; *Grouping Procedures; Higher Education; Institutional Characteristics; Institutional Research; Salary Differentials; *Teacher Salaries; Validity
IDENTIFIERS *AIR Forum 1979; *Biglan Method

ABSTRACT

The Biglan method of grouping academic disciplines for comparative purposes is discussed as well as an empirically-based system for making internal comparisons among different academic units. The clusters of disciplines developed by Biglan (pure and applied, soft and hard, life and nonlife) are useful guides in working with data involving classifying or categorizing academic departments. The types of data suited for use with Biglan groups and the methodologies for placing specific academic departments into Biglan categories are examined. Data demonstrating a relationship between faculty instructional data (salaries and workload) and Biglan categories are presented. It is concluded that while it does appear possible to use Biglan categories within and perhaps across institutions, care must be employed in their use. The Biglan categories provide a factually-based starting point for looking at groups of departments, as well as a means of identifying departments with which a given department may be compared. The Biglan disciplinary clusters and various statistical analyses of Biglan groups are tabulated. (Author/SF)

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ED174067

THE ASSOCIATION FOR INSTITUTIONAL RESEARCH

This paper was presented at the Nineteenth Annual Forum of the Association for Institutional Research held at the Town and Country Inn in San Diego, California, May 13-17, 1979. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC collection of Forum papers.

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AN EMPIRICAL MODEL FOR THE USE OF BIGLAN'S DISCIPLINARY CATEGORIES

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April, 1979

Abstract

The clusters of disciplines originally developed by Biglan have proven to be useful guides in working with data involving classifying or categorizing academic departments. However, at least two questions remain to be answered in working with Biglan categories: what types of data are suited for use with Biglan groups, and what methodologies are best for placing specific academic departments into Biglan categories?

This study provides data demonstrating a useful relationship between faculty instructional data and Biglan categories. It also explores several methodologies which might be used in identifying the most appropriate Biglan category for a given department.

Introduction

Comparisons of academic units, both within and across institutions, has been an increasingly important issue over the years. State and provincial boards, as well as campus administrators, have expressed the need to compare departments and programs for evaluation, accountability, staff planning, budget allocation, and the monitoring of departmental progress. Unit and program heads have, meanwhile, been pointing to the unique qualities of their disciplinary units when dealing with campus administrators, and campus administrators have emphasized the unique environment of their institutions when dealing with coordinating agencies. The purpose of this paper is to describe one empirically-based system for dealing with the issue of making internal comparisons among different units.

Review of the Literature

One pioneering attempt to develop rational ways in which to group academic disciplines for comparative purposes was that of Biglan (1973a). As the major part of his study, he surveyed 186 scholars at the University of Illinois at Urbana-Champaign to determine their perceptions of similarities among 36 separate academic departments. Using non-metric multidimensional scaling (Kruscal, 1964), Biglan found that each of the 36 academic areas could be categorized using only three dimensions. He labeled these three dimensions as: (a) the existence of a generally accepted core of problems to be solved with agreed upon methodologies (i.e., the existence of a paradigm as defined by Kuhn in 1962); (b) the degree of concern with application; and (c) the concern with life as opposed to non-life systems.

Biglan refers to those disciplines characterized as having widely accepted paradigms or core areas as being "hard" as opposed to "soft." He describes those areas primarily concerned with application as "applied," while those

with low concern for application are called "pure." Biglan names those areas with interest in living organisms as "life" areas, while those dealing primarily with inanimate objects are called "non-life." Using these three sets of descriptors, Biglan's three dimensions can be used to describe eight possible areas or categories. These areas are as follows: hard/pure/life (HPL), hard/pure/non-life (HPN), hard/applied/life (HAL), hard/applied/non-life (HAN), soft/pure/life (SPL), soft/pure/non-life (SPN), soft/applied/life (SAL), and soft/applied/non-life (SAN). The 36 departments at the University of Illinois, which Biglan used in his original study, were placed into these eight areas through the use of judgments of 186 faculty. The groupings of the departments are shown in Table 1.

Using his three dimensions as a conceptual base, Biglan (1973b) went on to examine other ways in which the departments so categorized differed among themselves when grouped together. He found that the various departmental groupings differed as to: (a) social connectedness of the scholars; (b) commitment to teaching, research, and service; (c) number of journal articles, monographs, and technical reports published by the faculty; and (d) number of dissertations sponsored.

Smart and Elton (1975) further tested the Biglan thesis by examining the differences in departmental goals and activities as reflected by departmental chairpersons. Not surprisingly, they found that departmental goals and activities differed significantly among the categories designated as hard vs. soft, pure vs. applied, and life vs. non-life. A natural assumption was that if the departmental goals and activities differed, then the amount of time department heads spent on various activities would also be different, since the duties of a department head should reflect the major thrust of the department; this was also found to be true by Smart and Elton (1976).

Table 1

Biglan Disciplinary Clusters

	Hard		Soft	
	Non-Life System	Life System	Non-Life System	Life System
Pure				
	Astronomy	Botany	English	Anthropology
	Chemistry	Entomology	German	Political Science
	Geology	Microbiology	History	Psychology
	Mathematics	Physiology	Philosophy	Sociology
	Physics	Zoology[1]	Russian[2]	
			Communications[3]	
Applied				
	Ceramic Engineering	Agronomy	Accounting	Educational Administration & Supervision[4]
	Civil Engineering	Dairy Science	Finance	Secondary & Continuing Education
	Computer Science	Horticulture	Economics	Special Education
	Mechanical Engineering	Agricultural Economics		Vocational & Technical Education

[1] Zoology was split into two departments and was not included in present study.
[2] Russian has been renamed Slavic Languages and was included in present study.
[3] Communications has been renamed Speech Communications and was included in present study.
[4] Educational Administration & Supervision was reorganized slightly and renamed as Administration, Higher & Continuing Education and was included in present study.

Considerable support is lent to the Biglan groups by the variety of data used in his and later studies relating to the groups. In developing the original groupings or categories, Biglan surveyed faculty at both a large, research oriented university and at a small college. He then focused on the data collected from the former group to identify disciplinary differences based on his groupings. Smart and Elton, utilizing data based on a nationwide sample of department heads, found essentially the same results.

In yet another study, Smart and McLaughlin (1978) surveyed faculty in a large, research oriented university, and used faculty activity data to study differences among faculty activities and salaries according to the Biglan categories. These results also suggest that faculty separated into groups on the basis of the Biglan categories spend their time differently and are rewarded differently depending on the group they are in, reflecting different underlying goals for the different groups.

Therefore, there is evidence from several sources validating the Biglan categories and suggesting ways in which these groups might be of use in studying institutions of higher education, particularly at the campus and departmental level.

Several difficulties remain before the Biglan categories can be routinely applied. One of these difficulties is that only a small number of departments were classified into the original Biglan groups. Administrators and others using the groups might well need to include departments not yet classified. A second problem is that departments may differ considerably among institutions, and the classification of a particular department might well be different at two different institutions, or even at the same institution at two different points in time. A department with primary interest in pure research at one institution and time, for example, might well have a primary interest

in application at another institution or a different time. In fact, departments at the University of Illinois, where Biglan developed the categories, no longer fit the original Biglan classification due to changes in a few departmental structures. Therefore, there appears to be a need for a way in which departments within a given institution may be classified into the Biglan categories.

The purpose of this study is two-fold. The first purpose is to present further data on the academic activities and salaries of faculty in the various Biglan groups which will support the validity of the Biglan categories. And, a second purpose is to suggest several methodologies which might be employed by an institution to place departments into the most appropriate Biglan groups.

Methodology

The primary sources of data used for the present study are the same as those used by Muffo (1979). Five variables measuring faculty activities were used to form ratios by dividing data for assistant professors by similar data for associate professors, dividing data for assistant professors by similar data for full professors, and by dividing data for associate professors by similar data for full professors in each of the departments. The five variables used to form the fifteen ratios used in the study are: the number of full-time equivalent faculty at each rank; the number of full-time equivalent students taught by faculty at each rank; the number of instructional units (credit hours) taught by faculty at each rank; the average salary of faculty at each rank; and the number of salary dollars spent per instructional unit taught by faculty at each rank. An example of one of the ratios used in the study is the ratio of the number of full-time equivalent assistant professors in the department to the number of full-time equivalent associate professors in the department. (A more complete description of the variables

used is provided in the footnote to Table 4.) A final variable used in the study was the American Council on Education (A.C.E.) disciplinary ratings as reported by Roose and Andersen (1970).

Three types of analyses were done in this study. Two sets of analyses of variance were conducted to determine if there were significant salary differences between different Biglan categories (hard vs. soft, etc.). In addition, the 15 variables previously described were used in multiple regressions to predict the A.C.E. rating of departments and faculty salaries by department. And, cluster analysis was used in an attempt to classify departments into the Biglan groups.

Results

The first analysis of the Biglan groupings was a comparison of average salaries by rank across Biglan category. For each of the six Biglan categories for which data were available, average faculty salaries were computed for the fall and spring semesters at the University of Illinois at Urbana-Champaign. These averages were then translated into constant dollars, using 1970 as the base. The departments used in the analysis are those presented in Table 1, with the changes noted in the footnote.

An analysis of variance of these average salary data showed that the disciplines in different Biglan categories did not, in fact, share a common salary scale. As the results presented in Table 2 show, all three of the Biglan dimensions had significantly different salaries for all three of the ranks. In other words, the departments in the "hard" areas had salaries that were significantly higher than those of "soft" departments, etc. It was also found that there were significant interactions among Biglan dimensions. For all three ranks, the "hard/soft" X "pure/applied" and the "pure/applied" X "life/non-life" interactions were significant. In addition, the "hard/soft" X

Table 2

Biglan Categories and 1970-1977 UIUC Salary Data, by Rank

Dimension	Asst. Professor		Assoc. Professor		Full Professor	
	F	Sign.*	F	Sign.*	F	Sign.*
Hard/Soft	28.14	.001	69.69	.001	22.88	.001
Pure/Applied	155.67	.001	35.93	.001	239.50	.001
Life/Non-Life	7.29	.01	40.73	.001	1014.41	.001
H/S x P/A	151.17	.001	199.57	.001	188.24	.001
H/S x L/N	1.17	n.s.	3.20	n.s.	135.95	.001
P/A x L/N	119.22	.001	167.83	.001	591.07	.001
H/S x P/A x L/N	3.43	n.s.	.82	n.s.	.07	n.s.

*df = 1,104

"life/non-life" interaction was significant for full professors. The three-way interaction was not significant for any of the three ranks.

The analysis of variance results indicate that all three of the Biglan dimensions are related to the size of the average salary of assistant, associate, and full professors. In addition, the interactions which were significant showed that the relationship between dimension and average salary changed when more than one dimension were considered. For example, even though "hard" departments were found to have higher average salaries than "soft" departments, the interaction results would imply that a "hard-pure" department might not necessarily have higher average salaries than a "soft-applied" department.

Since significant differences were found for all three dimensions and for all three faculty ranks, the University of Illinois data support the Smart and McLaughlin (1978) findings, which are that the Biglan categories are useful in distinguishing among departments in terms of salary policies.

In order to determine if the results of the University of Illinois analysis could be generalized across institutions, a second analysis was performed using data obtained from the "1977-78 Faculty Salary Survey" (Oklahoma State University, 1978) conducted by the Office of Institutional Research at Oklahoma State University. The Oklahoma State survey presents data on average faculty salaries by subject area and by faculty rank for faculty at 72 universities and land grant colleges across the country, including one or more state university campuses from nearly every state. Average salaries for the 72 institutions for assistant, associate, and full professors were divided into the Biglan groups by subject area, utilizing the same mapping used at the University of Illinois. An analysis of variance was then performed on these data.

The results of the analysis of variance are presented in Table 3. The table shows that one of the Biglan dimensions (hard/soft) did not divide the faculty on salary. While the data for the pure/applied and life/non-life dimensions do support the University of Illinois findings, the results are not as supportive of the Biglan groups as are the Illinois data. However, the results are surprisingly strong when the type of data being used is considered. The data used are salary averages across 72 institutions, by subject area and rank. This means that for the results to be positive, the faculty ranks, salary schedules, and the philosophical orientations of the departments at the 72 institutions have to be comparable. For example, if the mathematics departments at some institutions focus on applied mathematics while others deal mostly with pure mathematics, then the averaged data for the institutions would not be expected to fit into either the pure or applied Biglan catetory, but rather to fall in between the two extremes. Since the institutions included in the Oklahoma survey represent a diverse group, it would be expected that institutional differences would obscure some of the differences among Biglan categories. If the data were restricted to institutions which were more comparable in research emphasis, the results might show stronger relationships between Biglan dimensions and salary. In support of this, there is some evidence that discipline is a stronger predictor of faculty salary at larger, more research oriented universities than it is at other types of institutions (Gilbert, 1978).

The Oklahoma State data point out a shortcoming of the Biglan data presented so far. The best results have been found when University of Illinois data were used, and that is where Biglan developed the groups. Another institution might expect to make best use of the Biglan categories only if the departments at the institution were similar to the equivalent departments

Table 3

Analysis of Variance of Biglan Categories and Fall 1977
Oklahoma State University Salary Survey Data

Dimension	Asst. Professor		Assoc. Professor		Full Professor	
	F	Sign.*	F	Sign.*	F	Sign.*
Hard/Soft	.14	n.s.	.02	n.s.	.14	n.s.
Pure/Applied	52.31	.001	14.54	.001	.52	n.s.
Life/Non-Life	6.55	.05	10.76	.01	20.21	.001
H/S x P/A	12.90	.01	11.15	.01	.90	n.s.
H/S x L/N	1.12	n.s.	.01	n.s.	.89	n.s.
P/A x L/N	23.57	.001	27.22	.001	15.98	.001
H/S x P/A x L/N	1.13	n.s.	.84	n.s.	2.68	n.s.

*df = 1,25

at the University of Illinois. If either different departments or departments with different emphases were to be used, problems could be expected. While a given department might be correctly placed into a Biglan category through a matching of the characteristics of the department to the appropriate categories on each of the three Biglan dimensions, some departments might not have an intuitive fit. While it might also be possible to match the salary patterns of departments in each of the Biglan groups to departments not yet classified and use the best fit, it would appear that there should be some suitable objective analysis which would allow for classification.

One approach which might be used to place departments into suitable Biglan categories involves the use of American Council on Education (A.C.E.) rankings as reported by Roose and Andersen (1970). Muffo (~~in press~~ 1979) found that comparisons or ratios of faculty activity (teaching loads, etc.) and salaries among ranks in a given department correlated fairly highly with A.C.E. ranking of the department. For example, one of the ratios used was the number of full-time equivalent faculty at the assistant professor rank to the number of full-time equivalent faculty at the full professor rank. It seemed logical that if the relationship between these predictors and the A.C.E. rankings of the departments were more or less constant within a Biglan category (hard, applied, non-life, etc.), then it would be possible to determine if an unclassified department belonged in the category by how its addition to the category affected the correlation. If the data for the new department fit the data for the departments already in the group, then the correlation would be maintained. If, on the other hand, there was no fit, the correlation would drop. Thus, the change in the correlation might be used as an indicator of fit.

Table 4 presents data showing correlations of the ratios with A.C.E. ranking by Biglan area. The correlations are presented first for the Biglan group in its original form, and then for the Biglan group with trial departments added one at a time. The table shows that in some cases, such as with the HAN group, the original correlation was nearly matched when a trial department (e.g., electrical engineering) was added to the category. On the other hand, when chemical engineering was added to the hard/applied/non-life category, the correlation with A.C.E. ranking dropped considerably. This would tend to indicate that electrical engineering fit in with the other HAN departments, while chemical engineering did not. Further down the table it can be seen that when chemical engineering was added to the departments in the hard/pure/non-life category, the correlation for the group remained nearly unchanged, indicating a reasonable fit with the category. This conclusion is further supported by the fact that at the Urbana-Champaign campus of the University of Illinois, the chemical engineering department is in the College of Liberal Arts and Sciences, not in the College of Engineering, logically suggesting that it might be more "pure" than "applied."

Thus, while a combination of logic and the predictability of A.C.E. rankings appears to be useful in placing departments into Biglan categories, it does have a significant drawback in that not all departments appear in the A.C.E. rankings. What is needed is some criterion which is available for all departments, and which relates to the predictors in much the same way as A.C.E. ranking.

Since faculty is one of the dimensions on which the Biglan groups differ (see Table 2) and since faculty salary should be available for any department, one approach might be to predict faculty salary by rank (some adjustment must be made for rank, since it correlates with salary). To

Table 4

Prediction of A.C.E. Rankings from Biglan Categories and Faculty Activity Data

Biglan Category	R	Sign.	N[1]	Variables Entering[2]
HAN (Hard/Applied/Non-Life)	.96	.01	28	1,2,6,10,15
HAN and Electrical Engineering	.94	.01	42	3,10,12,14
HAN and Chemical Engineering	.78	.01	42	1,9,10
HAN and Electrical Engineering, Chemical Engineering	.58	.01	56	1,10
HPL (Hard/Pure/Life)	.71	.01	70	3,7,11
HPL and Biochemistry	.60	.01	84	2,3
SPN (Soft/Pure/Non-Life)	.91	.01	56	3,8
SPN and French, Span-Ital-Port.	.68	.01	84	3,4,10
SPN and Classics, Linguistics	.90	.01	84	3,9,12,13,15
SPN and French, Span-Ital-Port., Classics, Linguistics	.86	.01	112	3,4,7,10,12,14,15
SPL (Soft/Pure/Life)	.79	.01	56	6,10,11
HPN (Hard/Pure-Non-Life)	.71	.01	84	6,7,13,14
HPN and Chemical Engineering	.70	.01	98	6,7,13,14
HPN and Biochemistry	.67	.01	98	4,5,7,13,14

[1] The number of departments for each of 14 semesters may differ from those of previous tables, since not all departments included were in the A.C.E. ratings.

[2] Only those variables which entered the regression significantly are shown. The numbers refer to the numbered variables in the following list:

(1) Number of asst. professors/number of assoc. professors in the department.
(2) Number of asst. professors/number of full professors in the department.
(3) Number of assoc. professors/number of full professors in the department.
(4) No. of FTE students per asst. prof./no. of FTE students per assoc. prof.
(5) No. of FTE students per asst. prof./no. of FTE students per full prof.
(6) No. of FTE students per assoc. prof./no. of FTE students per full prof.
(7) No. of credit hrs per FTE asst.prof./no. of credit hrs per FTE assoc.prof.
(8) No. of credit hrs per FTE asst.prof./no. of credit hrs per FTE full prof.
(9) No. of credit hrs per FTE assoc.prof./no. of credit hrs per FTE full prof.
(10) Average asst. professor salary/average assoc. professor salary.
(11) Average asst. professor salary/average full professor salary.
(12) Average assoc. professor salary/average full professor salary.
(13) Cost per credit hr. for asst. prof./cost per credit hr. for assoc. prof.
(14) Cost per credit hr. for asst. prof./cost per credit hr. for full prof.
(15) Cost per credit hr. for assoc. prof./cost per credit hr. for full prof.

determine if salary might be used as a criterion to group departments, the faculty activity data used to predict A.C.E. ranking (minus those variables including salary) were used to predict average faculty salary by rank by Biglan category. As before, the correlations were first computed using the departments originally placed in the Biglan groups and then the correlations were recomputed with trial departments added. As before, the goodness of fit should be reflected by the size of the change in the correlation, if any.

The results of the analysis are shown in Table 5. For each Biglan category, multiple correlations are shown for each faculty rank, predicting average faculty salary from various measures of faculty activity. As in Table 4, the correlations are repeated with a trial department added to those in the Biglan group. When the correlations are the same or larger, the relationship between faculty activities and average faculty salary is the same for the departments in the Biglan group and for the trial department, indicating that the department might belong in the Biglan group. The data presented in the table show a somewhat disturbing finding in that this method yields different results than were found when A.C.E. rankings were predicted using a similar methodology. For example, the A.C.E. ranking data suggested that chemical engineering belongs in the hard/pure/non-life group, while the data shown in Table 5 suggest that chemical engineering belongs in hard/applied/non-life. Since the same predictors were used in both cases, it must be assumed that the average salary data reflect a different and unrelated quality of the departments than do the A.C.E. ranking data.

One final approach was tried in classifying departments into the Biglan groups. Using the faculty activity data, the faculty salary data, and the A.C.E. ranking data, the departments were placed into groups on the basis of the geometric distance among departments in an N-dimensional space where

Table 5

Predicting Average Faculty Salary by Rank from Biglan Categories and Faculty Activity Data

Biglan Category	Asst. Prof. R	Asst. Prof. Sign.	Assoc. Prof. R	Assoc. Prof. Sign.	Full Prof. R	Full Prof. Sign.
HAN (Hard/Applied/Non-Life)	.24	n.s.	.79	.01	.78	.01
HAN and Electrical Engineering	.70	.01	.76	.01	.81	.01
HAN and Chemical Engineering	.45	.01	.94	.01	.94	.01
HAN and Electrical Engineering, Chemical Engineering	.59	.01	.88	.01	.95	.01
HPN (Hard/Pure/Non-Life)	.27	.05	.56	.01	.58	.01
HPN and Chemical Engineering	.30	.01	.38	.01	.41	.01
HPN and Biochemistry	.19	n.s.	.64	.01	.64	.01
HPN and Geography	.83	.01	.69	.01	.93	.01
HPL (Hard/Pure/Life)	.62	.01	.46	.01	.46	.01
HPL and Biochemistry	.44	.01	.47	.01	.76	.01
HPL and Geography	.54	.01	.40	.01	.71	.01
SPL (Soft/Pure/Life)	.77	.01	.40	.01	.46	.01
SPL and Geography	.50	.01	.20	n.s.	.50	.01
SPN (Soft/Pure/Non-Life)	.76	.01	.34	.05	.45	.01
SPN and French, Span-Ital-Port.	.71	.01	.47	.01	.44	.01
SPN and Classics, Linguistics	.67	.01	.72	.01	.52	.01
SPN and French, Span-Ital-Port., Classics, Linguistics	.45	.01	.62	.01	.52	.01

each variable represented one of the dimensions. Using this method, the two departments whose means on the variables are most similar will be placed together, since the geometric distance between them will be smaller than for any other pair of departments. Once the departments have been combined, new means are calculated and the process is repeated until the desired number of groups is arrived at.

Table 6 shows the results of the first attempt at grouping the departments. As the table shows, the results of the first attempt at grouping departments using faculty activity data and salaries, by rank, did not yield ideal results. The table shows the eight-group result or level, with the groups the departments were clustered into on the left margin, and the Biglan groups the departments were originally in across the top. None of the eight groups corresponds directly with any of the original Biglan groups. Instead, three of the eight groups contain only full professors, and four of the eight contain only assistant and associate professors. This suggests that rank may be more important in determining the activities and salary of a faculty member than department.

A further look at the data presented in Table 6 shows that the Biglan dimensions were more or less followed, though only one at a time. The first group consists mainly of "hard" departments. The second group is made up mostly of "pure" departments, as is the fourth group, and the fifth, seventh, and eighth groups. However, the groupings found were quite different from the original Biglan groups. It was felt that two possible problems might be forcing the results into the configuration found. One, already mentioned, was that faculty rank seemed to interfere with the grouping. A second was that the data were not standardized, so that some of the variables were weighted more heavily than others.

Table 6

Group Analysis Results--All Ranks, Unstandardized Variables, Eight Group Solution

Group	H/P/N	H/A/N	H/P/L	S/P/N	S/A/N	S/P/L	Other
1	Physics *Asst Prof* *Assoc Prof* Mathematics *Asst Prof* *Assoc Prof*	Civil Engr. *Asst Prof* *Assoc Prof* Mech. Engr. *Asst Prof* *Assoc Prof*	Entomology *Asst Prof* *Assoc Prof* Zoology *Asst Prof* *Assoc Prof*		Economics *Asst Prof* *Assoc Prof*		Elect. Engr. *Asst Prof* *Assoc Prof* Music *Asst Prof* *Assoc Prof* Span-Ital-Port. *Asst Prof* *Assoc Prof* Chem. Engr. *Asst Prof* *Assoc Prof*
2	Astronomy *Asst Prof* *Assoc Prof* Geology *Asst Prof* *Assoc Prof*		Botany *Asst Prof* *Assoc Prof* Physiology *Asst Prof* *Assoc Prof*	English *Asst Prof* *Assoc Prof* History *Asst Prof* *Assoc Prof*		Anthropology *Asst Prof* *Assoc Prof* Political Sci. *Asst Prof* *Assoc Prof* Sociology *Asst Prof* *Assoc Prof*	French *Asst Prof* *Assoc Prof*
3							Classics *Asst Prof* *Assoc Prof* *Full Prof* Biochemistry *Asst Prof* *Assoc Prof*
4	Chemistry *Asst Prof* *Assoc Prof*			German *Asst Prof* *Assoc Prof*		Psychology *Asst Prof* *Assoc Prof*	Geography *Asst Prof* *Assoc Prof* Linguistics *Asst Prof* *Assoc Prof*

Table 6 (Con't.)

Group	H/P/N	H/A/N	H/P/L	S/P/N	S/A/N	S/P/L	Other
4 (Con't.)				Philosophy *Asst Prof* *Assoc Prof*			
5			Microbiology *Asst Prof* *Assoc Prof*				
6	Physics *Full Prof* Astronomy *Full Prof* Geology *Full Prof* Mathematics *Full Prof*	Civil Engr. *Full Prof* Mech. Engr. *Full Prof*	Botany *Full Prof* Entomology *Full Prof* Zoology *Full Prof*	English *Full Prof* History *Full Prof*	Economics *Full Prof*	Anthropology *Full Prof* Political Sci. *Full Prof* Sociology *Full Prof*	Elect. Engr. *Full Prof* Music *Full Prof* French *Full Prof* Linguistics *Full Prof* Span-Ital-Port. *Full Prof* Chem. Engr. *Full Prof*
7	Chemistry *Full Prof*		Physiology *Full Prof*	German *Full Prof* Philosophy *Full Prof*		Psychology *Full Prof*	Geography *Full Prof*
8			Microbiology *Full Prof*				Biochemistry *Full Prof*
TOTAL	15	6	15	12	3	12	27

Table 7 presents the eight-group solution to the grouping process with the variables standardized. A comparison of these data with those presented in Table 6 shows that only a slight improvement was made by standardizing the variables. Two of the six Biglan groups represented were squeezed into one fewer group each, two were reordered into slightly more reasonable groups, and two were unchanged. The departments not included in the original Biglan groups were also placed with somewhat more logical groups, but the overall result still fell somewhat short of expectations.

Since the standardization of the variables did not remove the effect of faculty rank, a third analysis was performed, with data for all three ranks combined by department. The results of this analysis are shown in Table 8. With the data standardized and presented by department, as opposed to by department and rank, the results of the analysis are much simpler to interpret than the previous analyses. In this solution, all eight of the groups were aligned with at least one of the three Biglan dimensions. In other words, all the departments in any one of the eight groups have at least one Biglan dimension in common (i.e., all are hard or pure or non-life, etc.). Unfortunately, the relation is not perfect, and four of the six Biglan categories represented in the data are in two or more of the eight groups produced. And, the two Biglan groups which are in only one of the groups formed by this analysis, hard/applied/non-life and soft/applied/non-life, are both in the same cluster analysis group.

Thus, it would appear that grouping departments by the geometric distance between them on faculty activity data does not yield results comparable to the Biglan groups. Since the procedure utilized simply groups departments with the least linear distance between them on the variables used, this failure raises some questions. Apparently, the faculty activity data do not fully

Table 7

Group Analysis Results--All Ranks, Standardized Variables, Eight Group Solution

Group	H/P/N	H/A/N	H/P/L	S/P/N	S/A/N	S/P/L	Other
1	Physics *Asst Prof* *Assoc Prof* Geology *Asst Prof* *Assoc Prof* Mathematics *Asst Prof* *Assoc Prof*	Civil Engr. *Asst Prof* *Assoc Prof* Mechan. Engr. *Asst Prof* *Assoc Prof*	Botany *Asst Prof* *Assoc Prof*	History *Asst Prof* *Assoc Prof*	Economics *Asst Prof* *Assoc Prof*	Anthropology *Asst Prof* *Assoc Prof* Political Sci. *Asst Prof* *Assoc Prof*	Elect. Engr. *Asst Prof* *Assoc Prof* French *Asst Prof* *Assoc Prof* Span-Ital-Port. *Asst Prof* *Assoc Prof*
2	Chemistry *Asst Prof* *Assoc Prof* *Full Prof*		Microbiology *Asst Prof* *Assoc Prof* *Full Prof*	German *Asst Prof* *Assoc Prof* *Full Prof* Philosophy *Asst Prof* *Assoc Prof* *Full Prof*		Psychology *Asst Prof* *Assoc Prof* *Full Prof*	Music *Asst Prof* *Assoc Prof* *Full Prof* Geography *Asst Prof* *Assoc Prof* *Full Prof*
3	Astronomy *Asst Prof* *Assoc Prof* *Full Prof*						
4							Classics *Asst Prof* *Assoc Prof* *Full Prof* Biochemistry *Asst Prof* *Assoc Prof* *Full Prof*

Table 7 (Con't.)

Group	H/P/N	H/A/N	H/P/L	S/P/N	S/A/N	S/P/L	Other
5			Physiology *Asst Prof* *Assoc Prof* *Full Prof*	English *Asst Prof* *Assoc Prof* *Full Prof*		Sociology *Asst Prof* *Assoc Prof* *Full Prof*	Linguistics *Asst Prof* *Assoc Prof* *Full Prof*
6			Entomology *Asst Prof* *Assoc Prof* *Full Prof* Zoology *Asst Prof* *Assoc Prof* *Full Prof*				
7							Chem. Engr. *Asst Prof* *Assoc Prof* *Full Prof*
8	Physics *Full Prof* Geology *Full Prof* Mathematics *Full Prof*	Civil Engr. *Full Prof* Mechan. Engr. *Full Prof*	Botany *Full Prof*	History *Full Prof*	Economics *Full Prof*	Anthropology *Full Prof* Political Sci. *Full Prof*	Elect. Engr. *Full Prof* French *Full Prof* Span-Ital-Port. *Full Prof*
TOTAL	15	6	15	12	3	12	27

Table 8

Group Analysis Results--Standardized Variables, Eight Group Solution

Group	H/P/N	H/A/N	H/P/L	S/P/N	S/A/N	S/P/L	Other
1	Physics Mathematics	Civil Engr. Mechan. Engr.			Economics		Elect. Engr. Music Span-Ital-Port.
2	Geology		Botany Physiology	English History		Anthropology Political Sci. Sociology	French Linguistics
3	Astronomy						
4							Classics Biochemistry
5			Entomology Zoology				
6	Chemistry			German Philosophy		Psychology	Geography
7			Microbiology				
8							Chem. Engr.

measure the factors underlying the Biglan dimensions. An alternative possibility is that there are one or more factors not included in the Biglan dimensions which were tapped by these data. Further research would be required to determine the source of the problem.

Discussion and Conclusions

Several studies done since Biglan's original work was published have pointed to the validity of the hard/soft, pure/applied, and life/non-life dimensions he proposed for categorizing academic disciplines. The research reported here relating Biglan categories with A.C.E. rankings, faculty activities, and faculty salaries, generally support the same conclusion. Departments which are academically similar do tend to share similar modes of teaching and research, and they also tend to have similar faculty pay scales.

Several methods were also suggested for placing those departments not originally included in the Biglan categories into the most appropriate group. Those approaches using A.C.E. rankings are, of course, useful with only a small number of departments, but those using average faculty salaries by rank, along with faculty activity data, could prove useful to a wide range of institutions.

The data presented here do not speak to the question of how a department should function, but rather only provide some basis for representing how the department has functioned historically. In addition, the Biglan categories may not cover all the important dimensions of difference between departments, nor do they imply cause and effect. It is possible, especially during a period of rapid change, that some outside factor(s) could influence one or more departments in a Biglan category without influencing all the departments in that category.

A major gap in this type of research is that comparisons across institutions are not readily available, despite the fact that many colleges and universities routinely collect the type of data necessary to conduct such research. This problem is confounded by the fact that most of the published work concerning Biglan groups took place at large, research oriented universities, which may be presumed to share a great many characteristics. The data presented on cross-institutional comparisons, using the Oklahoma State University Salary Survey (1978), suggest that institutional differences in higher education may be sufficiently large to make global comparisons impractical.

In conclusion, while it does appear possible to use Biglan categories within and perhaps across institutions, some care must be employed in their use. They provide a factually based starting point for looking at groups of departments, as well as a means of identifying departments with which a given department may be compared. Sufficient research has been conducted to conclude that the Biglan categories are sound, but it appears that departments must be reclassified into the Biglan groups at each institution to be sure that institutional differences haven't caused an error.

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